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ABSTRACT

A study investigated the effectiveness of using a small-group discussion as the main vehicle for the construction of an initial representation of a problem that activates previously acquired knowledge. College students (N=39) were randomly assigned to either an experimental condition or a control condition and asked to brainstorm about a presented problem and to propose explanations. The free recall protocols produced by the subjects were first passed into subject-predicate units (or clauses) each expressing a single idea. In addition, the clauses were categorized as either "explanatory" or "descriptive." One-way analysis of variance were carried out on the data, and it was found that subjects in the problem analysis discussion group produced more than twice as many correct clauses as compared with the control group. The problem analysis group also produced a significantly larger proportion of explanatory clauses whereas the control group produced a larger proportion of descriptive clauses. Results suggest that problem analysis using small-group discussions not only activates prior knowledge but encourages subjects to reconstruct their existing knowledge in such a way that a more coherent "situation model" is produced. Contains 10 references. (DB)

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Can Previously Acquired Knowledge be Activated through Small-Group Discussion?

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Research in the domain of text processing has well established the crucial role played by existing cognitive structures in the comprehension of expository texts. Prior knowledge acts as a frame of reference within which new information can be understood and enables scaffolding for the representation of new concepts in memory (Anderson, Spiro & Anderson, 1978). However, prior knowledge needs to be **activated** in order to provide a context for the integration of new information from text (Bransford and Johnson, 1972).

Several instructional methods have attempted to deal with the problem of the integration of new knowledge into old. The literature suggests at least three distinctive approaches. The first is to encourage the production of elaborations based on prior knowledge, while studying a text. Examples are: asking students to answer questions about a text , take notes, or write a summary of a text (Mayer, 1985). The second is to provide students, prior to reading, with a description of a concrete model which can be considered an analogy of the concepts to be understood. For example: descriptions of mechanical models, concrete advance organizers and metaphors (Royer & Cable, 1976). These analogies are supposed to bridge the gap between what is already known and what should be learned.

More recently, a third approach has been suggested, namely to encourage learners to construct an explanatory model themselves, prior to the processing of new information. Typically, students are confronted with the description of a set of natural phenomena, or witness an experiment, and are asked to generate an explanation for the phenomena, or predict the outcome of the experiment, based on their prior knowledge (Champagne, Klopfer and Gunstone,1982). Subsequently, they read an expository text on the subject, are lectured about it, or see the actual result of the experiment.

In this paper, a variation on this paradigm is proposed, that is, using small-group discussion as the main vehicle for the construction of an initial representation of the problem (Schmidt, 1982). In this approach, small groups of learners are given the description of a set of natural phenomena, e.g.: "A red blood cell is put into pure water under a microscope. The blood cell swells rapidly and eventually bursts. Another red blood cell is added to a solution of salt in water and is observed

to shrink." The learners are asked to explain these phenomena in terms of underlying processes, principles or mechanisms. After discussing this problem for some time and proposing possible explanations, based on prior knowledge of these or similar phenomena, they are presented with a text which provides explanatory information relevant to the problem.

The supposition here is, that the analysis of a problem by small-group discussion activates relevant prior knowledge, which facilitates subsequent text processing. The purpose of the present experiment was, to determine the extent to which small-group discussion, aimed at explaining natural phenomena, is an effective means for activating previously acquired information on a subject.

METHOD

Subjects were 39 college students : 31 females and 8 males. Average age was 19.4 years, with a standard deviation of 1.1. Their academic background included biology, although it was not part of their present training. The subject of osmosis (the biological process explaining the blood cell problem) had been part of a course given almost two years before the experiment was carried out.

Materials consisted of a description of the blood cell problem and a free recall test. The free recall test consisted of three blank pages and a front page giving the following instruction: "Write down everything you remember about osmosis and diffusion. Write in full sentences and avoid a telegram style or drawings".

Procedure. The subjects were randomly assigned to either an experimental condition or the control condition. Subsequently, the extent to which both groups differed in prior knowledge of biology was checked using grades on previous examinations of biology. No significant differences were found.

The experimental group was then subdivided in three small groups of about equal size. To each of these groups an experimenter was assigned. She briefly explained what was expected from the subjects, by means of a written example consisting of a description of the behavior of a plant

releasing oxygen in daylight, but not in the dark. In a 400-word text this phenomenon was analyzed from a few different points of view and a number of more or less elaborate explanations were offered. The experimenter actively involved subjects to check their understanding of the way they were to proceed with the experimental problem. She emphasized that they were to brainstorm about possible explanations for the problem and to analyze the explanations offered by discussing them critically. This introduction took five to ten minutes. Subsequently, the experimenter informed the subjects that a maximum of 15 minutes was available for formulating explanations and issued the problem description. After reading the problem for about one minute, the subjects began to propose explanations. The experimenter acted as a chairperson, summarizing the different points of view at regular intervals. It was verified, by audiotaping the discussion, that she did not provide information from which subjects could derive insights into the underlying mechanisms of the problem at hand. None of the groups needed more than 10 minutes for the problem. Subsequently, the free recall test was administered to both experimental and control groups.

Scoring. The free recall protocols produced by the subjects were first parsed into subject-predicate units (or clauses), each expressing a single idea, using a technique proposed by Winograd (1983). In addition, the clauses were categorized as either 'explanatory' or 'descriptive'. An explanatory clause was defined as a statement explaining either a process, or describing the conditions under which a process occurs. All other clauses were considered descriptive. This analysis was included because according to Mayer (1985) the number of explanative clauses in free recall is a sensitive measure of depth of integration of subject-matter. The explanation/description distinction appeared to be relevant in the light of the specific assignment given to the subjects, namely to produce explanations for the phenomena observed. In addition, it was considered a viable alternative for the number of inferences as a (more commonly used) measure of integration (Van Dijk & Kintsch, 1983), simply because, in the present experiment, no text was used from which anything could be inferred by the subjects.

Interrater agreement for this task was 79 %.

RESULTS AND DISCUSSION

Table 1 displays the average number of correct clauses in the protocols of the problem-analysis group and the control group.

Table 1: Average number of correct clauses produced

	Mean	SD	N
Problem-analysis group	27.2	9.1	20
Control group	11.8	5.4	19
Total	19.7	7.5	39

One-way analyses of variance were carried out on the data. The differences between the mean total number of clauses produced are statistically significant ($F(1, 37)= 44.98$, $p= .000$). Similar results were found for the number of correct clauses produced ($F(1, 37)= 40.43$, $p= .000$). These results suggest that problem analysis by means of small-group discussion is an effective activator of knowledge learned in the past. The problem-analysis group produces more than twice as many clauses as compared with the control group. The point-biserial correlation between experimental manipulation and the dependent variable is $r_{pbis}= .72$, indicating that the presence or absence of problem analysis explains almost 52 % of the variance in the number of clauses produced.

It should be noted that it is not the presence or absence of an activator, per se, that causes the effect, because prior knowledge of the control group can be expected to have been activated by the instruction to write down everything remembered about osmosis and diffusion. The specific format of the activator, the presentation of a problem in combination with a discussion aimed at the

construction of a model explaining the phenomena decribed, must be held responsible for the differences observed. Further evidence for this assertion is provided by the data summarized in Table 2, which shows the average number of explanatory and descriptive clauses produced.

Table 2: Average number of explanatory and descriptive clauses produced

	Explanations	Descriptions	N
Problem-analysis group	14.4	12.8	20
Control group	4.4	7.5	19
Total	9.7	10.2	39

These differences are again highly significant, due to the large difference in total numbers of clauses recalled. Comparing relative numbers of clauses produced (and, by doing that, discarding the difference in absolute output) significant differences are still found. The problem-analysis group produces a significantly larger proportion of explanatory clauses ($z= 4.03$, $p< .0001$), whereas the control group produces a larger proportion of descriptive clauses ($z= 3.37$, $p< .0001$).

These data appear to indicate that problem analysis by means of small-group discussion not only activates prior knowledge but, due to the specific nature of the task, encourages subjects to reconstruct their existing knowledge on osmosis and diffusion such that a more coherent "situation model" (Kintsch, 1986) is produced. Alternatively, the task may have prompted the experimental subjects to specifically look for explanatory clauses in long-term memory. Given the data at hand, it is impossible to distinguish between these two hypotheses. However, the larger free recall of the experimental group suggests a better organization of their knowledge in memory. Because

scientific subject-matter tends to be organized in causal networks (Gentner and Stevens, 1983), the first hypothesis may be more likely.

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